FURNACE SYSTEM WITH MOVABLE LOCK CHAMBER

The invention relates to a furnace system for the thermal treatment of elongated material, especially a roller hearth furnace, comprising a conveying unit which supplies the material, comprising a furnace having a gastight-closable charging opening and comprising a lock chamber having a gastight-closable charging opening, which connects the furnace to the conveying unit, wherein the lock chamber receives the material in batches via the charging opening and feeds into the furnace.

In furnace systems known from the prior art, the conveying units which transport the material to be treated, the lock chamber and the furnace are arranged in a line. Especially when treating particularly elongated material such as, for example, steel or copper pipes, extreme installation lengths are obtained since not only the furnace itself but also the lock chamber arranged in the line must completely receive the elongated material. Such installations must be installed in correspondingly designed machine halls which is associated with considerable investment costs.

It is thus the object of the invention to provide a furnace system for elongated material which is distinguished by a compact design compared with the prior art.

The object is solved according to the invention in a furnace system according to the preamble of claim 1 by the fact that the furnace is arranged outside the conveying direction of the conveying unit and the lock chamber is displaceable from a first position in which it

receives the material supplied to it from the conveying unit, into a second position in which it docks with its charging opening onto the charging opening of the furnace in a gastight fashion.

Since the lock chamber according to the teaching of the invention is not arranged in a fixed position, but is displaceable between a first position in which it receives the material supplied to it from the conveying unit, into a second position in which it docks with its charging opening onto the charging opening of the furnace in a gastight fashion and feeds the material into the furnace, it is no longer necessary to arrange the conveying unit and the furnace linearly one after the other. Depending on the respectively selected kinematics of the movement of the lock chamber, for example, turning or sliding or a combined movement, it is possible to have a parallel staggered or an angular arrangement of the furnace relative to the conveying unit which in any case results in a significant reduction of the installation length.

Thus, according to an advantageous embodiment of the invention the furnace is arranged alongside adjacent to the conveying unit and the lock chamber is substantially slidable perpendicular to the conveying direction, wherein the material is fed into the furnace in a direction opposite to the conveying direction. Through this arrangement the installation length can be shortened at least by the length of the furnace. An alongside arrangement of the furnace next to the conveying unit also brings about only a minimal broadening of the installation width. More appropriately for this purpose the lock chamber is mounted on a carriage which can be slid on rails.

According to a particularly advantageous embodiment of the invention, the furnace has a gastight-closable discharge opening opposite to the charging opening, a second lock chamber with a gastight-closable charging opening and a second conveying unit, wherein the second lock chamber is displaceable from a first position in which it docks with its charging opening onto the discharging opening of the furnace in a gastight fashion and receives the material discharged from the furnace, into a second position in which it supplies the material to the second conveying unit. By means of this arrangement the compact furnace system according to the invention can be operated continuously by feeding the material through the first lock chamber into the furnace via its charging opening and after completion of the heat treatment, discharging it from the furnace via the discharging opening and transporting it further using the second conveying unit.

In this arrangement the furnace can have a heating section and a cooling section arranged therebehind, wherein the material fed into the furnace is first heat-treated, then cooled in a controlled fashion and after completion of this process step, is discharged via the discharge opening.

A particularly effective separation of the protective gas atmosphere in the furnace from the ambient air can be achieved by constructing the lock chamber as a vacuum chamber. This means that the lock chamber is first evacuated and then, before opening the charging opening of the furnace, is filled with the protective gas likewise present in the furnace. For this purpose the furnace more appropriately has before its charging

opening a docking unit via which the lock chamber can be evacuated and filled with protective gas.

Finally, according to a further embodiment of the invention it is provided that the charging opening of the furnace can be closed in a gastight fashion by a pull door.

The invention is explained in detail in the following with reference to the drawings which show merely one exemplary embodiment. In the figures:

Fig. 1 shows a furnace system for a continuous treatment with two movable lock chambers in a lateral side view and

Fig. 2 shows the furnace system from Fig. 1 in plan view.

The furnace system in Fig. 1 comprises a furnace 1, which is designed in a symmetrical fashion and constructed as a roller hearth furnace, for the heat treatment of elongated material, especially of copper pipes 8, with a heating section 1a and a cooling section 1b. As can be seen from Fig. 2, the copper pipe 8 travels through the furnace from left to right, is thus first heat-treated and then cooled in a controlled fashion. Before the heating section 1a, the furnace 1 has an inlet space 1c with a charging opening 1d which is closable in a gastight fashion preferably by a pull door 1g. In accordance with the symmetrical structure of the furnace 1, in the direction of travel after the cooling section 1b the furnace 1 has an outlet space 1e with a discharge opening 1f which in the same way as the inlet space 1c is

closable in a gastight fashion preferably by a pull door 1h.

Before the charging opening 1d and after the charging opening 1f of the furnace 1, there is respectively one docking unit 2, 3 onto which a lock chamber 4, 5 can dock. Both docking units 2, 3 are each connected via a connecting piece 2a, 3a to a device not shown for separate evacuation and filling of the docking units 2, 3 with protective gas.

The lock chambers 4, 5 are constructed as vacuum chambers and are arranged before or behind the furnace seen in the direction of travel. They serve to feed or remove the copper pipes 8 into or out of the furnace 1. Both lock chambers 4, 5 each have a gastight-closable charging opening 4a, 5a by means of which they can dock onto the docking units 2,3 allocated to them. The lock chambers are each mounted on a carriage 4b, 5b which for its part is mounted on rails 4c, 5c. By moving the respective carriage 4b, 5b on the rails 4c, 5c, the lock chambers 4, 5 can each be moved from a position I in which they are docked onto the docking units 2, 3 of the furnace 1, into a position II in which they are each arranged at the end of a conveying unit constructed as a rolling table 6, 7.

The mode of operation of the furnace system is as follows: first, the copper pipe 8 is moved over the rolling table 6 in the direction of the arrow 6*. In this case, the lock chamber 4 is located in position II so that the copper pipe 8 can be introduced into the lock chamber 4. The lock chamber 4 is then moved together with the copper pipe 8 on the carriage 4b by means of a motor drive not shown into the position I in which it can be docked onto the docking unit 2 of the furnace 1. It

is then moved by a further drive not shown in accordance with the double arrow 4* in the direction of the furnace 1 until it is docked onto the docking unit 2 on the front side and forms a gastight connection to the docking unit 2. In the next step the docking unit 2 and the lock chamber 4 associated with it is evacuated via the connecting piece 2a and subsequently filled with protective gas.

By opening the pull door 1g a connection is then made from the docking unit 2 to the inlet space 1c of the furnace 1 and the copper pipe 8 is fed from the lock chamber 4 into the furnace 1 in accordance with the direction of the arrow 1*. In this case, the lock chamber 5 on the furnace outlet side is also in the position I and is connected to the furnace 1 via the docking unit 3 and the opened pull door 1h. In the furnace the copper pipe 8 is first heat-treated in the heating section 1a and then cooled again in the cooling section 1b in a controlled fashion. It is then transported through the outlet space 1e and the docking unit 3 into the lock chamber 5 via its charging opening 5a. As soon as the copper pipe 8 has completely passed the discharging opening 1f of the furnace, this is closed in a gastight fashion by the pull door 1h so that no ambient air can penetrate into the furnace 1 of the furnace.

In the following step the lock chamber 5 is moved away slightly from the docking unit 3 in accordance with the double arrow 5* by means of a drive not shown and is then moved over the rails 5c by a further drive not shown from the position I into the position II. There the finished heat-treated and cooled copper pipe 8 is transported further from the open lock chamber 5 over the rolling

table 7 in accordance with the direction of the arrow 7* and is thus supplied to storage or further processing.